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ABSTRACT

A case is developed for including social issues in science teaching, based on a belief that such inclusion can make science more meaningful and can contribute to the development of intelligence. The Human Sciences Project, in which science and related social issues are combined in curriculum modules for students ages 11-14, is described. The content of these interdisciplinary modules is grouped into problem areas and levels of student competence. Also described are materials being developed for senior high school and college students. Other aspects of these curricula, such as student and public acceptance, and the ability of science instructors to teach social issues, are discussed. (MH)

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SOCIAL ISSUES IN SCIENCE CURRICULA

by
James T. Robinson
Biological Sciences Curriculum Study

My central concern in this paper is to describe two contemporary examples of the inclusion of social issues in experimental science curricula. However, I will embed this description in a discussion of two related issues. First, why teach science-related social issues in science classes and second, what are some of the more important constraints on the inclusion of such issues in science classes.

The multiplicity of problems where scientific knowledge is a necessary, but not sufficient basis for solution are constantly in public view. The scientific community and by implication, scientific knowledge, is found in support of diametrically opposed solutions. A populous that seems to have believed that facts speak for themselves with singular consequences following from them has become disenchanted with a science that seems to leave alternatives and that finds scientists themselves interpreting scientific data in different ways. Not only is scientific knowledge itself in question as a contributor to the solution of significant societal problems, but the very methodology of science is rejected by a significant proportion of the American population.

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A typical approach to the teaching of science has been to cover a large amount of what is considered to be the fundamental content of the various sciences in the school curriculum. If these topics are not "covered," students are considered to be unprepared for the next level in their education. Our assumption has been that if students understand findings that scientists have made, they will be able to apply these findings to solutions in their own lives. Armed with such knowledge, they will be able to contribute, as citizens, to the solutions of problems as they arise at some time in the future. This assumption of automatic application has been frequently questioned.

The literature of science education has continually stressed the importance of teaching students application of knowledge to practical problems. Unfortunately, when curriculum materials finally reach the classroom, application, if it was ever present, is gradually eliminated in order to include everyone's favorite content in a particular field. Every curriculum developer knows these pressures. I find myself constantly plagued with the question of, "Why haven't you included genetics," or "You don't have enough emphasis on machines." At one level of discourse, we have a seemingly persuasive argument that science must be taught as inquiry, that transfer of knowledge is not automatic, that applications of knowledge to the real world must be taught rather than relegated to some nebulous time in the future. Yet, our decision-making, when it comes to the production of curriculum

materials and to the education of teachers, gradually leads to an abandonment of these goals. Each time new curricula are developed, we are asked to demonstrate that, at least, the students have not lost what previous curricula have been assumed to have provided. After this accomplishment is met, new learnings become admissible. Such a view, unless it can be modified, will continue to plague us in seeking the development of effective means of educating non-scientists in using scientific knowledge in their daily lives. Teaching the application of scientific knowledge to problems significant to students generally requires a discussion of social issues. We must, therefore, leave out some of the subjects and topics that have been traditionally taught at the grade level in question to make time available to discuss the related social issues. We must also begin to think more seriously about how we teach the general student what scientific knowledge is, what it isn't, what its limitations are, and what it takes in a civilization to support further development of the scientific way of understanding. I say this not to minimize or exclude the necessity of teaching students other ways of knowing. I think this is imperative. In fact, I think that much of the enthusiasm of the movement in science curricula in the past two decades have trapped many of us into scientism--assuming that the scientific way of knowing is the only way of knowing needed by the human organism.

I believe that if science is going to be learned, it must be meaningful to individuals in the context of their lives at the time they are learning it. For most young people, the exhortation that they will need this in the future, they have to have it to go to college, or they will need it for graduate school, does not make the subject of study meaningful. In the long run, it may alienate. One way in which scientific knowledge can be made meaningful, is to include the practical applications of such knowledge in the world of students.

We have all heard a great deal about public disenchantment with science. Etzioni and Nunn (1974) reviewed national public opinion polls and attitude surveys within the last couple of decades. Those limited, and as they stated, rather thin data supported their thesis that "...although science has lost some support, many defectors are among politically weaker, less informed, less educated groups." They suggested that these groups cannot "...be said to be simply disaffected; our data suggest that a person's attitudes toward science are a complex set, which can be mobilized for or against science, depending on which facet is activiated." They asked this question, among others, "To reach the most indifferent segments of the public, should the goals of science be modified so that they are more relevant socially and economically to 'forgotten Americans?'" I cannot answer for science, but my answer for science education is yes, it is imperative that we do.

It is not because I am thinking of the students who have earned A's and perhaps B's in their one senior high school

course, but the students who have earned C's and D's and some who have failed. These individuals, by our usual pattern of grading, are the majority of citizens who are voting daily, purchasing and acting in terms of their comprehensions of scientific knowledge. I am suggesting that the goals of science education need to more clearly focus on science as a way of knowing with its limitations and the limits of its applications. We need to forego an encyclopedic approach. I'm suggesting that the content of science serve the problems that are raised, shedding light on problems where such light can be shed, and calling on other ways of knowing and other areas of knowledge when they contribute to resolving the problems raised. Here, we need also to stress the value base of the sciences themselves. The natural sciences are not value-free, but are based on a series of value judgments and metaphysical principles that are beyond proof.

In summary, my case for advocating the inclusion of social issues in the teaching of science is based primarily on a belief that such inclusion can make science and scientific knowledge more meaningful and therefore more useful to a wide range of students for whom the field is now meaningless, if not irrelevant. It can contribute to the development of intelligence.

What can we do and how can we do it? Two curriculum efforts that I have been associated with have attempted to move instruction in this direction. I have been engaged for the last five years in the development and testing of Human Sciences. The Human Sciences Project staff* has been developing a program

*Supported by the National Science Foundation

of instruction for emerging adolescents, ages 11 to 14. From the very start, we suggested that knowledge both from the social and natural sciences should be utilized where appropriate to deal with problems, objects and events that could be made meaningful and significant to youngsters who are leaving childhood and growing into adolescence. We did not see the utility in producing another curriculum that asked, "How can we make key ideas in the sciences understandable to youngsters." We asked, "How can the disciplines serve the child's development--cognitive, social, and moral?" Approaching curricula this way, has lead us to try to determine the interests youngsters of these ages have or can develop and how their concerns can be utilized as a basis for bringing new ideas and new knowledge to these students.

In 1973-74, we tested five modules with sixth graders in seven school systems throughout the United States. In 1974-75, we tested four modules with the same students, then seventh graders. In 1975-76, we are testing the last four modules in the program with the same students, now in the eighth grade.

Our first year, Level I modules, are titled BEHAVIOR, SURVIVAL, SENSE...OR NONSENSE, LEARNING, and GROWING. In each of these modules, we have posed problems and have tried, where we could, to bring knowledge from both the natural and social sciences to bear on them. This interdisciplinary approach to curricula has great potential for the future. It is not the easiest kind of curricula to develop. A unique feature of the program is that modules consist of activities

grouped into problem areas. The students can choose the activities they wish to do. There is no required activity in any problem area or in any module. Activities are designed for different levels of students competence. We have tried to provide, within activities, for a range of possible outcomes so that students with different skill levels could be successful. Success may be different for each student. In the Level I materials, we have precursors for dealing with social issues--many activities focused on human variability. For example, in the LEARNING module we included an interview activity entitled "What Do You Think of That?" This activity included a set of 24 numbered flash cards and an information data sheet. Students interviewed men and women, and boys and girls as to their feelings about the topic of the flash card. They asked the person inteviewed, "Each card you are about to see has a word and a matching picture. When I flash a card, you're to tell us how you feel about it by saying good, so-so, or bad." We had such subjects as rain, snow, cigarettes, frogs, marijuana, atom bomb, country, city, smog, and others. Students tallied responses in such a way that they built histograms of frequencies of each kind of response on each card. This and other activities evoked the response of students that they didn't realize how people differed so much in their opinions about such things. They had assumed that they and their friends defined the range of opinion. This activity and others lead many students to indicate that they didn't realize that people were so different. They usually said

really different, as if they had known it in one sense but not known it in another.

A major theme of the Level I materials is the development of systems of classroom management. Students are doing a variety of activities at one time so they must become a part of the management system. It cannot be left in the hands of teachers alone. Developing competence in environmental management is too important for students. Students must learn to function as real contributors to a finite environment--the classroom is usually over-populated and has a limited supply of resources. We planned the curriculum this way by providing only five to ten copies of a single activity. Frequently, there are only enough materials so that from 2 to 4 students can use activities at one time. This means that conflicts and priorities have to be settled as a part of the management of the social system. Conflicting values and conflicting needs are a part of the real environment in which the student has to learn to function. With the guidance of effective teachers, foundations are built for further development of student competence in dealing with science-related social issues.

Another example of what I mean by precursors to science-related social issues is in the care and feeding of animals in the classroom. Many projects have found that it is difficult to maintain live materials in classrooms, that live materials must be easily provided to the teacher. They have found that as external support and the excitement of a new curriculum wears off, the number of living organisms in classrooms declines. Our attempt is to shift the burden of responsibility for the

care of organisms to the students so that they learn to value caring for organisms and participate, directly in developing personal responsibility and responsible social systems for the humane care of these organisms. I don't mean to say that this can happen all at once. One of the major problems that one faces in building such systems into classrooms is to deal with an initial response of just dumping the full responsibility on the students and expecting that they can handle them. We are trying to learn how one deals with increments of growth.

At the senior high school and undergraduate college level, we have been engaged in developing materials based upon the idea of investigations. These materials attempt to stimulate problem formulation by students. Unlike the laboratory exercise, even the more open-ended types, a key phase of instruction and learning are concerned with formulating and clarifying a problem. Problem formulation is a difficult task. It is a task that students have had little or no experience with and one that some previously successful students find exasperating. The purposes of formulation and clarification are to enable students to become engaged in a problem that gets to be important enough to them that they are committed to seeking its resolution.

Students engage in problem clarification by selecting a general topic for investigation. They are then asked to consider seven categories of factors that may affect the problem and to generate a question or several questions within

each category. The categories are: physical laws, politics and the law, environmental impact, economics--public and private, attitudes and feelings, health and safety, and design and technology. Each of these categories is defined, and examples of problems are provided in the student materials. For example, a topic such as "Energy Use in Home Gardens" might include a problem such as "Will soil treated with animal fertilizer grow as good a crop as soil treated with chemical fertilizers?," in the Physical Laws category, and in the Design and Technology category, a problem such as "How much energy goes into the production of fertilizers for home gardens?" might be suggested.

A final phase of the investigation is to deal with the issue, "If I could advise my community on (my topic), what would I suggest?" In arriving at this last problem, a system for value analysis is provided and explained. Students are to utilize a value analysis scale as they plan their recommendations. The scale runs from -10 to 10, with 0 as a dividing line between the negative values--for effects considered to be negative--and the positive values--for effects considered to be positive. A key idea here is for students to assign value weights on the basis of their analysis, but to learn that data do not speak for themselves--they are valued and weighted by the investigator. Some investigators may judge one effect as positive while others will judge it negative. Within each value parameter, the weights given to an affect will vary.

In tests classes, the variety of issues investigated ranged widely: promotion of rock concerts, solar energy, bike paths, electric energy and windmills, nuclear power, churches, hydropower, police stations, solar cooling, etc. These investigations varied widely in the amount of attention given to each of the categories of factors that could influence the problem and its resolution.

Does the general public accept science curricula that include social issues? This question is probably impossible to answer. Our experience in the classrooms in which Human Sciences is being tested is largely positive. The major concern of parents is to question whether children in such a curriculum can compete in science classes with students who have had more conventional science instruction. We do not yet know how our students will fare in the senior high school.

In parent meetings, parents have reviewed the curriculum and have found it exciting. They have been supportive of the program and its perceived effects on their children. An NSF panel, that included parents, recently reviewed the curriculum, were highly supportive of the rationale, objectives, and materials. We know, however, that there is a very active minority that is outspoken in criticism of such curricula and would prefer that this kind of curriculum alternative not be available to any schools.

Curriculum developers support such program in theory, but they are wary of the resistance to change in the schools.

Several publishers' representatives whom I have talked with estimate that five percent of school systems in the United States are willing to try new approaches to instruction. They feel that ninety-five percent of the school systems will not venture far from what they have previously offered. They treat these feelings as facts in estimating potential markets. In this way, publishers exert a powerful influence on materials that can become available for selection by school systems. Many publishers feel that science curricula that include social issues will not be perceived as real science curricula by science curriculum adoption committees. If curricula move too far into interdisciplinary content, the materials can be viewed as not having a slot in school course structures, and therefore, have no market.

There is a strong feeling that science teachers cannot handle science-related social issues. This concern is expressed by some publishers representatives, by some school administrators, and by some science department heads. There is a general lack of confidence in teacher competence. Conversely, we find many teachers who review the Human Sciences materials, express their concern that administrators might not let them use such materials, or that parents might not approve.

These fascinating examples of one groups perception of others can be resolved. We have convened community seminars in our test schools in which all parties, including professors

of education, are included. In such seminars, it is more difficult for one group to say what the other groups think. They can speak for themselves.

We need more effective science education for the citizen, especially the citizen who completes general education at the high school level. I urge that we devote resources to curriculum research at the pre-college level. I do not mean just continuation of current pre-college curriculum development such as that supported by the National Science Foundation. This effort needs continuing support, but the criterion of success by which NSF and Congress evaluate successful curriculum projects is whether and how they are marketed through the private sector. Curriculum research, devoted to how students learn science in a variety of school contexts could inform foundation and government funded curriculum projects. It might eventually contribute to more effective materials produced by the private sector.

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